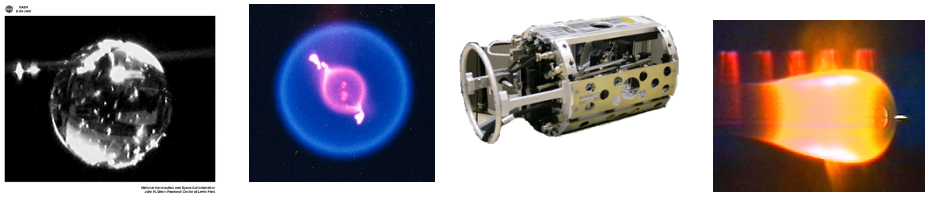
Flame Extinguishment Experiment-2 (FLEX-2)

PI Team: Prof. Forman Williams, UCSD (lead)
Prof. Frederick Dryer, Princeton
Prof. Mun Choi, University of Connecticut
Prof. Benjamin Shaw, USC-Davis
Dr. Vedha Nayagam, NCSER
Prof. Thomas Avedisian, Cornell
Dr. Daniel Dietrich, NASA GRC

PS: Michael Hicks, NASA GRC
PM: J. Mark Hickman, NASA GRC
Engineering Team: ZIN Technologies, Inc.



Left to Right: Image of Bi-component fuel droplet; color image of burning single fuel droplet; FLEX Chamber Insert Assembly Apparatus; image of burning droplet subjected to convective flows.

Objective:

- **Extend the results of FLEX-1 to fuels and environmental conditions that mimic real combustor conditions**
  - Investigate bi-component fuels – real fuels are multi-component
  - Examine the influence of sub-buoyant convective flows – real combustors involve gas/ droplet relative motion
  - Study practical fuels and fuel surrogates
  - Study binary droplet arrays – real combustors have droplet-droplet interactions
  - Develop and validate detailed and reduced-order transport, chemistry and soot models that are the foundation for real engine simulations

Relevance/Impact:

- **The combustion of liquid fuels is the overwhelming energy source in the transportation sector**
  - Design future combustors to minimize carbon footprint (maximize fuel efficiency) and minimize pollutant emissions
  - The development of surrogates (mixtures of pure fuels that simulate the behavior of real fuels) will allow quantitative evaluation of the performance of future fuels (e.g., oil shales, biofuels, etc.) in combustors
  - Prior droplet results helped validate jet engine models by engine manufacturers

Development Approach:

- **Flight design leverages off previous flight design heritage (MDCA/FLEX)**
- **Multi-user, re-usable apparatus minimizing up-mass/volume, costs, and crew involvement**

ISS Resource Requirements

Accommodation (carrier)	Combustion Integrated Rack
Upmass (kg) (w/o packing factor)	200 kg
Volume (m^3) (w/o packing factor)	0.08 m^3
Power (kw) (peak)	1.5 Kw
Crew Time (hrs) - Initial configuration of CIR Rack - Change-outs during experiment	 8.5 hrs 8.3 hrs
Autonomous Ops (hrs)	300 hrs
Launch/Increment	ULF-5/27-28 & 29-30

Project Life Cycle Schedule

Milestones	SCR	RDR/PDR	CDR	VRR	Safety (PH-3)	PSR	Ship	Launch	Ops	Return	Final Report
Actual/ Baseline	Nov 2007	Oct 2008	Feb 2010	—	Nov 2009	Jun 2010	Jun 2010	ULF-5	Mar 2011	June 2012	June 2013